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REMARKS

Reconsideration of the above-identified application in view of the present amendment is respectfully requested. By the present amendment claim 29 was amended to change the terms "first mold wall" and "second mold wall" to, respectively, "first wall portion" and "second wall portion". This amendment was made to overcome the 35 U.S.C. §112 rejection in item 3 of the Office Action.

Additionally, with respect to the "Other Documents" of the information disclosure statement (IDS), the authors of these documents are unknown because these document were downloaded from various websites, which did not list the authors of documents. The titles, publishers, and date of publications for these respective documents listed below in the order they are listed in the IDS:

(1) Multibase, Multiflex, A whole range of thermoplastic elastomers, published by Multibase, (Date Unknown);

(2) Engage, A Product of Dupont Dow Elastomers, Dupont Dow Elastomers, 1998;

(3) Phoenix Plastic Co., Inc., CFA's (Chemical foaming Agents), Phoenix Plastic Co., Inc., 1999; and

(4) Arnitel, General Information on Application and Properties, DSM Engineering Plastics, (Date Unknown).

Additional information with respect to the publication date of these documents is unknown. It should be noted though that all of these documents were downloaded from the internet on 5/09/2001. Hence, all of these documents can have a publication of this date since they were printed by the applicants' representative on this date.

Below is a discussion of the 35 U.S.C. §102(e) rejection and the 35 U.S.C. § 103 rejections presented herein in the order that they are presented in the Office Action.

35 U.S.C. §102(e) rejection of claims 1-4, 7, 8, 11-13, 15, 18-22, 24, 27, and 28

Claims 1-4, 7, 8, 11-13, 15, 18-22, 24, 27, and 28 were rejected under 35 U.S.C. §102(e) as being anticipated by Reidy et al.

Claim 1 recites a steering wheel comprising a rim portion, a spoke portion, and a foamed padding material adhered to at least one of the rim portion and the spoke portion. The foamed padding material includes a first portion and second portion. The first portion has a cellular structure and a substantially uniform cell density. The second portion has a continuous external surface free of interruption by cell. The

foamed padding material comprises a gasified chemical foaming agent and a thermoplastic polyolefin elastomer.

Claim 1 is patentable over Reidy et al. because Reidy et al. do not teach (1) a padding material comprising a thermoplastic polyolefin elastomer and a gasified foaming agent, and (2) a padding material of a thermoplastic polyolefin elastomer with a continuous external surface free of interruption by cell.

As noted in the Office Action, Reidy et al. teach a padding material comprising a thermoplastic elastomer. Reidy et al. teach that the thermoplastic elastomer can be Arnitel EM 400. As discussed in the background section of the present application and in the Arnitel reference provided in the IDS, Arnitel EM 400 is not a polyolefin thermoplastic elastomer, but a polyester.

Reidy et al. also teach that thermoplastic elastomers, such as polypropylene can be used for the steering wheel. Reidy et al. however, do not teach that the polypropylene is used in combination with a gasified foaming agent. Additionally, although suggested by Reidy et al., polypropylene is not a thermoplastic elastomer. Polypropylene as defined in Hawley's Condensed Chemical Dictionary (a copy of the relevant page is enclosed) is a crystalline thermoplastic polymer. It is not a thermoplastic elastomer in and of itself. Polypropylene must be combined with an additional polymer that has amorphous properties to form a thermoplastic elastomer. (Textbook of Polymer Science, 3d. ed., p. 379, (1984), a copy of which is enclosed.) Therefore, even though Reidy et al. teach that polypropylene is an example of a thermoplastic elastomer, this is not an accurate statement and thus Reidy et al. cannot be relied on to teach that a thermoplastic polyolefin elastomer.

Reidy et al. also do not teach a padding material of a thermoplastic polyolefin elastomer with a continuous external surface free of interruption by a cell. Reidy et al., first, only disclose a thermoplastic resin has the structure disclosed in Fig. 4, with an external skin and underlying core. Reidy et al. do not teach that this thermoplastic resin is a thermoplastic polyolefin elastomer. Reidy et al. further do not teach that the padding material has an external surface free of interruption by cell. Referring to Fig. 4 of Reidy et al., which depicts a padding material on a steering wheel, the padding material includes numerous cells across the surface 20 of the padding material. Thus, the external surface of the padding material is not free of interruption by cell. Therefore, Reidy et al. do not disclose or suggest all of the limitations of claim 1 and withdrawal of the 102(e) rejection of claim 1 is respectfully requested.

Claims 2-4, 7, 8, and 11 depend either directly or indirectly from claim 1 and therefore should be allowable because of the aforementioned deficiencies of the rejection with respect to claim 1 and for the specific limitations recited in claims 2-4, 7, 8, and 11.

Claim 12 includes limitations similar to claim 1 and therefore should be allowable because of the aforementioned deficiencies of the rejection with respect to claim 1 and for the specific limitations recited in claim 12.

Claims 13, 15, and 18 depend either directly or indirectly from claim 12 and therefore should be allowable because of the aforementioned deficiencies of the rejection with respect to claim 12 and for the specific limitations recited in claims 13, 15, and 18.

Claim 19 includes limitations similar to claim 1 and therefore should be allowable because of the aforementioned deficiencies of the rejection with respect to claim 1 and for the specific limitations recited in claim 19.

Claims 20-22, 24, 27, and 28 depend either directly or indirectly from claim 19 and therefore should be allowable because of the aforementioned deficiencies of the rejection with respect to claim 19 and for the specific limitations recited in claims 20-22, 24, 27, and 28.

35 U.S.C. §103(a) rejection of claims 2, 5, 6, 13, 14, 22, and 23

Claims 2, 5, 6, 13, 14, 22, and 23 were rejected under 35 U.S.C. §103(a) as being unpatentable over Reidy et al. in view of Oseroff et al.

Claim 1 is patentable over Reidy et al. in view of Osteroff et al. because Reidy et al. in view of Oseroff do not disclose or suggest a padding material comprising a thermoplastic polyolefin elastomer and a gasified chemical foaming agent and that the padding material has a continuous external surface free of interruption by cell.

As discussed above with respect to claim 1, Reidy et al. do not teach or suggest a padding material for a steering wheel comprising a thermoplastic polyolefin elastomer and a gasified chemical foaming agent. Reidy et al. only teach a foamed polyester thermoplastic elastomer. Moreover, Reidy et al. do not teach that the padding material has an external surface free of interruption by cell. Fig. 4 of Reidy et al depicts the padding material on a steering wheel that includes numerous cells across the surface 20 of the padding material.

Oseroff et al. teach thermoplastic rubbers that can be used for grips, which are wound around steering wheels. The thermoplastic rubbers in Oseroff et al. can include polyolefins. Oseroff et al. further teach that the grips or tapes can be foamed.

Oseroff et al., however, do not teach or suggest that the foamed tapes have a first portion with a continuous cell structure and a second portion with a continuous external surface free of interruption by cell.

Thus, Reidy et al. and Oseroff et al. do not teach or suggest a padding material for a steering wheel that includes a continuous external surface free of interruption by a cell; therefore, claim 1 is allowable.

Claims 2 depends directly from claim 1 and therefore should be allowable because of the aforementioned deficiencies of the rejection with respect to claim 1 and for the specific limitations recited in claim 2.

Claim 12 contains similar limitations to claim 1 and therefore should be allowable for the aforementioned deficiencies discussed with respect to claim 1 and for the specific limitations recited in claim 12.

Claims 13 and 14 depend from claim 12 and therefore should be allowable because of the aforementioned deficiencies of the rejection with respect to claim 12 and for the specific limitations recited in claims 13 and 14.

Claim 19 contains similar limitations to claim 1 and therefore should be allowable for the aforementioned deficiencies discussed above with respect to claim 1 and for the specific limitations recited in claim 19.

Claim 22 and 23 depend from claim 19 and therefore should be allowable because of the aforementioned deficiencies of the rejection with respect to claim 19 and for the specific limitations recited in claim 22 and 23.

35 U.S.C. §103(a) rejection of claims 9, 10, 16, 17, 25, and 26.

Claims 9, 10, 16, 17, 25 and 26 were rejected under 35 U.S.C. §103(a) as being unpatentable over Reidy et al. in view of Braun et al.

Claim 1 is patentable over Reidy et al. in view of Braun et al. because Reidy et al. in view of Braun et al. do not disclose or suggest a padding material comprising a thermoplastic polyolefin elastomer and a gasified chemical foaming agent and that the padding material has a continuous external surface free of interruption by cell.

As discussed above with respect to claim 1, Reidy et al. do not teach or suggest a padding material for a steering wheel comprising a thermoplastic polyolefin elastomer and a gasified chemical foaming agent. Reidy et al. only teach a foamed polyester thermoplastic elastomer. Moreover, Reidy et al. further do not teach that the padding material has an external surface free of interruption by cell. Fig. 4 of Reidy et al depicts the padding material on a steering wheel that includes numerous cells across the surface 20 of the padding material.

Braun et al. teach expand polyolefin granules. Braun et al. do not teach a padding material for a steering wheel comprising a thermoplastic polyolefin elastomer and a gasified chemical foaming agent. Moreover, Braun et al. do not teach that a padding material has an external surface free of interruption by cell.

Therefore, Reidy et al. in view of Braun et al. do not teach or suggest all of the limitations of claim 1; therefore, allowance of claim 1 is respectfully requested.

Claim 9 depends from claim 1 and therefore should be allowable because of the aforementioned deficiencies of the rejection discussed above with respect to claim 1 and for the specific limitations recited in claim 9.

Claim 10 depends from claim 9 and further recites that the resin carrier is essentially the same material as the thermoplastic polyolefin elastomer. Claim 10 is allowable because of the aforementioned deficiencies discussed above with respect to claim 9 and for the specific limitations recited in claim 9.

Additionally, claim 10 is allowable over Reidy et al. in view of Braun et al. because Reidy et al. teaches away from using a resin carrier that is essentially the same material as the thermoplastic polyolefin elastomer. Reidy et al. states at column 9, lines 34-48 that adhesion problem exist when foaming agent includes an olefinic carrier. An olefin carrier may migrate to the surface over time and cause adhesion degradation to paint or cover adhered to a rim. Thus, Reidy et al. teach away from using a resin carrier that includes an olefin such as a thermoplastic polyolefin elastomer. Therefore, withdrawal of the rejection of claim 10 is respectfully requested.

Claims 16 and 25 contain similar limitations to claim 9 and therefore should be allowable for the aforementioned deficiencies discussed above with respect to claim 9 and for the specific limitations recited in claim 16 and 25.

Claims 17 and 26 contains similar limitations to claim 10 and therefore should be allowable for the aforementioned deficiencies discussed above with respect to claim 10 and for the specific limitations recited in claim 17 and 26.

35 U.S.C. §103(a) rejection of claims 29-33, 35 and 37

Claims 29-33, 35 and 37 were rejected under 35 U.S.C. §103 as being unpatentable over Reidy et al. in view of Clarke.

Claim 29 recites a method of manufacturing a steering wheel. In the method, a thermoplastic polyolefin elastomer and a foaming agent are mixed. The mixture of the thermoplastic polyolefin elastomer and the foaming agent are heated to a temperature above the melting temperature of the thermoplastic polyolefin elastomer. The melted thermoplastic polyolefin elastomer is foamed with the foaming agent. A mold is

provided having a first wall portion and a second wall portion. The first wall portion defines a first cavity in which a rim portion of a steering wheel armature is disposed. The second wall portion defines a second cavity in which a spoke portion and the steering wheel armature are disposed. The temperature of the first wall portion is maintained at a first temperature below the melting temperature of thermoplastic polyolefin elastomer. The temperature of the second wall portion is maintained at a second temperature. The second temperature is substantially lower than the first temperature. The foamed thermoplastic polyolefin elastomer is transferred into the first cavity and the second cavity. The foamed thermoplastic polyolefin elastomer is cooled to a temperature below the melting temperature of the thermoplastic polyolefin elastomer adhering to the rim portion and spoke portion of the steering wheel armature.

Claim 29 is patentable over Reidy et al. in view of Clarke because Reidy et al. in view of Clarke do not teach or suggest (1) the step of mixing a thermoplastic polyolefin elastomer and a foaming agent and (2) maintaining a first wall portion, which defines a cavity in which the rim of a steering wheel is disposed at a first temperature and maintaining a second wall portion, which defines a cavity in which the spoke portion and steering wheel armature are disposed at second temperature, lower than the first temperature.

As discussed above with respect to claim 1, Reidy et al. do not teach or suggest mixing a thermoplastic polyolefin elastomer and a foaming agent. Reidy et al. only teach a foamed polyester thermoplastic elastomer. Clarke likewise does not teach mixing a thermoplastic polyolefin elastomer and a foaming agent. Clarke teaches foaming a polypropylene. Polypropylene is not a thermoplastic polyolefin elastomer. Thus, Reidy et al. in view of Clarke do not teach or suggest mixing a thermoplastic polyolefin elastomer and a foaming agent.

Additionally, Reidy et al. do not teach maintaining wall portions, which define first and second cavities, respectively, for the rim portion and the spoke portion and armature at different temperatures.

As noted in item 9 of the Office Action, Clarke teaches a mold wall portion can be cooled at different sections to control the degree of foaming. Clarke, however, do not teach maintaining a first wall portion, which defines a cavity in which the rim of a steering wheel is disposed at a first temperature and maintaining a second wall portion, which defines a cavity in which the spoke portion and steering wheel armature are disposed at second temperature, lower than the first temperature. In fact, Clarke

mentions nothing on why it would be advantageous to maintain one part of a mold for forming a padding material for a steering wheel at one temperature while maintaining a second part of a mold for forming a padding material at a second temperature. Thus, there is nothing that suggests modifying Reidy et al. in this manner.

Additionally, Clarke provides no motivation modify Reidy to maintain a first wall portion, which defines a cavity in which the rim of a steering wheel is disposed at a first temperature and maintaining a second wall portion, which defines a cavity in which the spoke portion and steering wheel armature are disposed at second temperature, lower than the first temperature. Clarke teaches forming a cup of plastic material not a padding material for a steering wheel.

The Office Action suggests that it would be obvious to provide the mold of Reidy et al. with the cooling ducts of Clarke, in order to ensure the lesser density reduction in the airbag cover of Reidy et al. Assuming arguendo, that this statement is correct, this statement provides no motivation for maintaining the wall portion, which defines the cavity for the rim portion, at a different temperature than the wall portion, which defines the spoke portion. A spoke portion is not an air bag cover.

Thus, Reidy et al. and Clarke do not disclose or suggest maintaining a first wall portion, which defines a cavity in which the rim of a steering wheel is disposed at a first temperature and maintaining a second wall portion, which defines a cavity in which the spoke portion and steering wheel armature are disposed at second temperature, lower than the first temperature.

Therefore, withdrawal of the rejection of claim 29 is respectfully requested.

Claims 30-33, 35, and 37 depend either directly or indirectly from claim 29 and therefore should be allowable because of the aforementioned deficiencies of the rejection with respect to claim 29 and for the specific limitations recited in claims 30-33, 35, and 37.

35 U.S.C. §103(a) rejection of claims 33 and 34

Claims 33 and 34 were rejected under 35 U.S.C. §103(a) as being unpatentable over Reidy et al. in view of Clarke and Oseroff et al.

Claims 33 and 34 depend directly from claim 29. As discussed above with respect to claim 29, Reidy et al. in view of Clarke do not teach or suggest the step of maintaining a first wall portion, which defines a cavity in which the rim of a steering wheel is disposed at a first temperature and maintaining a second wall portion, which defines a cavity in which the spoke portion and steering wheel armature are disposed at second temperature, lower than the first temperature. Moreover, Oseroff et al. do

not teach or suggest the step of maintaining a first wall portion, which defines a cavity in which the rim of a steering wheel is disposed at a first temperature and maintaining a second wall portion, which defines a cavity in which the spoke portion and steering wheel armature are disposed at second temperature, lower than the first temperature. Therefore claims 33 and 34 should be allowable because of the aforementioned deficiencies of the rejection with respect to claim 29 and for the specific limitations recited in claims 33 and 34 should be allowable .

35 U.S.C. §103(a) rejection of claim 36

Claim 36 was rejected under 35 U.S.C. §103(a) as being unpatentable over Reidy et al. in view of Clarke and Braun et al.

Claims 36 depends indirectly from claim 29. As discussed above with respect to claim 29, Reidy et al. in view of Clarke do not teach or suggest the step of maintaining a first wall portion, which defines a cavity in which the rim of a steering wheel is disposed at a first temperature and maintaining a second wall portion, which defines a cavity in which the spoke portion and steering wheel armature are disposed at second temperature, lower than the first temperature. Moreover, Braun et al. do not teach or suggest the step of maintaining a first wall portion, which defines a cavity in which the rim of a steering wheel is disposed at a first temperature and maintaining a second wall portion, which defines a cavity in which the spoke portion and steering wheel armature are disposed at second temperature, lower than the first temperature. Therefore, claims 36 should be allowable because of the aforementioned deficiencies of the rejection with respect to claim 29 and for the specific limitations recited in claim 36 should be allowable.

In view of the foregoing, it is respectfully submitted that the above-identified application is in condition for allowance, and allowance of the above-identified application is respectfully requested.

Attached hereto is a marked-up version of the changes made by the present amendment. The attached page is captioned "AMENDED CLAIM 29 WITH MARKINGS."

Serial No. 09/933,534

Please charge any deficiency or credit any overpayment in the fees for this amendment to Deposit Account No. 20-0090.

Respectfully submitted,



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Amended Claim 29 with Markings

Claim 29 has been amended as follows:

(Amended) 29. A method of manufacturing a steering wheel, said method comprising the steps of:

mixing a thermoplastic polyolefin elastomer and a foaming agent;

heating the mixture of said thermoplastic polyolefin elastomer and said foaming agent to a temperature above the melting temperature of said thermoplastic polyolefin elastomer;

foaming said melted thermoplastic polyolefin elastomer with said foaming agent;

providing a mold having a first ~~mold~~ wall portion and a second ~~mold~~ wall portion, said first wall portion defining a first cavity in which a rim portion of a steering wheel armature is disposed, said second wall portion defining a second cavity in which a spoke portion and said steering wheel armature is disposed;

maintaining the temperature of the first wall portion at a first temperature below the melting temperature of thermoplastic polyolefin elastomer;

maintaining the temperature of the second wall portion at a second temperature, said second temperature being substantially lower than said first temperature;

transferring said foamed thermoplastic polyolefin elastomer into said first cavity and said second cavity; and

cooling said foamed thermoplastic polyolefin elastomer to a temperature below the melting temperature of said thermoplastic polyolefin elastomer adhering to said rim portion and spoke portion of said steering wheel armature.



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are similar to those of natural rubber. In obtaining high tensile strength, however, until higher elongations are good and is retained well at high natural rubber. The electrical properties are similar, saturated nature. The dynamic sluggishness over the temperature is lower with high internal friction and its buildup is high.

It is produced and used for inner tubes when tubeless passenger tires were nonpassenger tires still use tubes. mechanical goods. States was about 290 million lb in

polymers and copolymers of chloroprene are the first synthetic rubbers developed. They are known for their oil resistance, and can replace natural rubber in most of its applications. About 270 million

In addition, addition of hydrogen chloride to vinylacetylene dimerization of acetylene. This process is turning to the production of polyvinyl chloride and 3,4-dichlorobutene-

polymerization. Some types are polyisoprene. It introduces some crosslinking in the presence of an emulsion. The plasticity of the polymer. The process is retarded by freezing. It is entirely in the *trans*-1,4 form. As a result, it is not a rubber.

From that of other elastomers in that it does not contain magnesium oxide are the preferred. The reason why cause crosslinking is not known. The usual rubber accelerators are in the form of retarders of the cure. A few chemical retarders, however, among them antimony

Unlike many other elastomers, neoprene vulcanizates have high tensile strength (3500–4000 psi) in the absence of carbon black. No reinforcing effect is found with any filler. Suitably protected neoprene vulcanizates are extremely resistant to oxidative degradation. Weathering resistance and ozone resistance are quite good. Neoprene is slightly inferior to nitrile rubber in oil resistance, but markedly better than natural rubber, butyl, or SBR. The dynamic properties of neoprene are superior to those of most other synthetics and only slightly inferior to those of natural rubber. They are less affected by elevated temperature than those of natural rubber. Neoprene has been shown to make excellent tires but cannot compete with other elastomers in price. Its major uses include wire and cable coatings, industrial hoses and belts, shoe heels, and solid tires. Gloves and coated fabrics are made from neoprene latex.

Thermoplastic Elastomers

The term *thermoplastic elastomers* is currently used to describe a wide variety of materials that have elastomeric properties at ambient temperatures, but process like thermoplastics, obviating the need for the vulcanization step to develop typical rubberlike elasticity. The best known and most widely used thermoplastic elastomers, to which the name originally applied, are block copolymers of styrene (S) with butadiene (B) or isoprene (I) with the block structure S–B–S or S–I–S. The morphology and properties of these materials are described in Chapter 17D. Other polymers commonly termed thermoplastic elastomers are polyurethanes and copolyesters (Chapter 15) and blends of ethylene-propylene copolymers (Section C) with polypropylene.

As a family, the thermoplastic elastomers are beginning to replace other specialty rubbers in a wide variety of uses, for example, replacing neoprene in adhesives and wire and cable insulation. Including all types, about 400 million lb was sold in 1982.

Other Elastomers

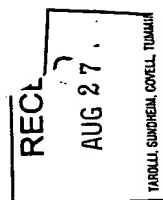
Several other elastomers have the status of specialty rubbers, at relatively low production volume and high price. Among these are chlorosulfonated polyethylene (Section C), the acrylate and various fluorocarbon elastomers (Chapter 14), polyurethane and polysulfide elastomers (Chapter 15), and silicone and epichlorhydrin rubbers (Chapter 16).

GENERAL REFERENCES

- Buckley 1965; Friedlander 1965; Hargreaves 1965; Kennedy 1968–1969; Brydson 1978, Chapters 10, 11, and 17; West 1978; Baldwin 1979; Finelli 1979; Johnson 1979b; McGrath 1979; Bonk 1982; Ellerstein 1982; Blackley 1983.

Hawley's
Condensed Chemical
Dictionary

TWELFTH EDITION
Revised by
Richard J. Lewis, Sr.



 VAN NOSTRAND REINHOLD COMPANY New

In affectionate memory of Alberta Gordon for her 50 years of dedicated help to many authors, including this one. Alberta edited this work and all eight editions of *Dangerous Properties of Industrial Materials*. She was recognized professionally for her work and personally by the authors she helped. Alberta will be missed.

In memory of George R. W. Lewis and Allen A. Ross; both had a lifelong interest in science facts.

Special thanks to Geraldine Albert, Craig Little, and Patti Brecht for expediting the editing of this manuscript on a tight schedule.

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CIP

1-EICOSANOL

1-eicosanol. See arachidyl alcohol.

5,8,11,14-elcostetraenoic acid. See arachidonic acid.

eigenenergy. Quantity of energy corresponding to a time-invariant atomic state.

eigenfunction. Wave function corresponding to a state with a definite value of some quantity.

Eigen, Manfred. (1927-). A German physicist who won the Nobel prize for chemistry in 1967. His research concerned the rate of hydrogen-ion formation through dissociation of water. He also was concerned with enzyme control. He received his degree at the University of Göttingen.

Einhorn-Brunner reaction. Formation of substituted 1,2,4-triazoles by condensation of hydrazines or semicarbazides with diacylamines in the presence of acid catalysts.

Einstein. The energy acquired by a gram-molecule weight of a substance when each molecule absorbs a quantum of excitation energy.

Einsteiniun. Es. A synthetic radioactive element with atomic number 99 and aw 253, discovered in the debris from the 1952 hydrogen-bomb explosion. Einsteiniun has since been prepared in a cyclotron by bombarding uranium with accelerated nitrogen ions in a nuclear reactor by irradiating plutonium or californium with neutrons, and by other nuclear reactions. The element is named for Albert Einstein. It has chemical properties similar to those of the rare-earth metal holmium. Isotopes are known with mass numbers ranging from 246 to 253. Einsteiniun has a valence of 2, and the lowest heat of vaporization of any divalent element. See also actinide series.

eka-. Prefix referring to element in next lower position in the same group in the periodic system.

ekahafnium. One of the last-discovered transuranic elements; atomic number 104. It has two α -emitting isotopes (257 and 259) and possibly a third (258). The former, made by bombardment of californium-249 with carbon-12 nuclei, has a half-life of five seconds and decays into nobelium-253. The 259 isotope, made by merging a carbon-13 nucleus with californium-249, has a half-life of three seconds and decays to nobelium-255.

"Ekono" [Carborundum]. TM for an engineering plastic composed of poly-p-oxymethylene.

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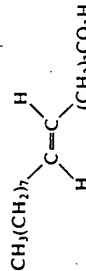
etc. Resistant to temperatures above 600C, self-lubricating surface.

Use: In pumps handling corrosive liquids, protective coating for titanium skins on supersonic transports, disk brakes, etc.

"ELA" [Du Pont]. Brand name for elastomer lubricating agent, a mixture of phosphate esters. Light amber liquid. Use: Unvulcanized rubbers.

elaboration. A term used in biochemistry to describe chemical transformations within an organism resulting in formation of specific types of substances; e.g., plants elaborate proteins and fats, and poisonous snakes elaborate their venom. It also refers to formation of metabolic end products such as purines and uric acid.

elaidic acid. (trans-9-octadecenoic acid). $\text{CH}_3(\text{CH}_2)_7\text{HC}=\text{CH}(\text{CH}_2)_7\text{COOH}$. The trans form of an unsaturated fatty acid of which the cis form is oleic acid.



Properties: White solid, d 0.8505 (79/4C), mp 43.7C, bp 288C (100 mm Hg), 234C (15 mm Hg), refr index 1.4358 (79C). Insoluble in water; soluble in alcohol, ether, benzene, and chloroform. Combustible.

Derivation: Synthesized from oleic acid by elaidinization.

Grade: Purified, 99+%. Use: Medical research, reference standard in chromatography.

elaidinization. Originally the reaction by which oleic acid is converted into elaidic acid, but now used in a more general sense to indicate the conversion of any unsaturated fatty acid or related compound from the geometric cis to the corresponding trans form. Nitrous acid and selenium compounds are commonly used as catalysts for this reaction. The resulting trans acids are more stable to oxidation.

elasticity. The ability of a material to recover its original shape partially or completely after the deforming force has been removed. The small amount of deformation that is not recovered is called permanent set or permanent elongation. Among common materials glass and some metals are virtually 100% elastic, whereas vulcanized rubber and other elastomeric substances are in the range of 90% elastic after extension to rupture.

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So-called perfect elasticity is a property of atoms which show no energy loss on collision. See also modulus of elasticity, stress, strain, plasticity.

elastic modulus. See modulus of elasticity.

elastin. A scleroprotein which occurs in connective tissue.

Properties: Yellow, fibrous mass; insoluble in water, dilute acids, alkalis, and salt solutions, and alcohol. Is partially digested by pepsin solution and wholly by trypsin.

elastomer. As originally defined by Fisher (1940), this term referred to synthetic thermosetting high polymers having properties similar to those of vulcanized natural rubber, namely, the ability to be stretched to at least twice their original length and to retract very rapidly to approximately their original length when released. Among the better known elastomers introduced since the 1930s are styrene-butadiene copolymer, polychloroprene (neoprene), nitrile rubber, butyl rubber, polysulfide rubber ("Thiokol"), cis-1,4-polyisoprene, ethylene-propylene terpolymers (EPDM rubber), silicone rubber, and polyurethane rubber. These can be cross-linked with sulfur, peroxides, or similar agents. The term was later extended to include un-cross-linked polyolefins that are thermoplastic; these are generally known as TPO rubbers. Their extension and retraction properties are notably different from those of thermosetting elastomers, but they are well adapted to such specific uses as wire and cable coating, automobile bumpers, vibration dampers, and specialized mechanical products.

"Elbasols" [Holliday]. TM for solvent dyes. Use: In the coloration of plastics.

"Elbetrons" [Holliday]. TM for disperse dyes. Use: Mainly on triacetate and polyester materials.

"Ethenyls" [Holliday]. TM for selected acid dyes. Use: On nylon materials.

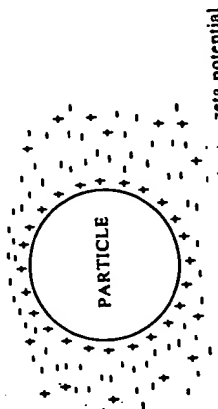
Elbs persulfate oxidation. Hydroxylation of phenols to p-diphenols by potassium persulfate in alkaline solution.

Elbs reaction. Formation of anthracenes by intramolecular condensation of diaryl ketones containing a methyl or methylene substituent adjacent to the carbonyl group.

electric double layer. A diffuse aggregation of positive and negative electric charges surrounding

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ing a suspended colloidal particle which aids in maintaining its stability. According to the Gouy-Freundlich theory, advanced about 1920, a close-packed array of charges is attached to the surface of the particle while a diffuse layer of charges of opposite sign extends into the liquid. The particle is electrically neutral. There is an electrokinetic potential gradient across the double layer that is called the zeta potential. The diagram is an approximation of this phenomenon. Modifications of this theory have been introduced in recent years, notably by Derjaguin and Landau and by Verwey and Overbeek (DLVO theory). See also zeta potential.



electric furnace. See furnace.

electric steel. Steel made in an electric furnace.

electric vehicle propulsion. See storage battery.

electride. An experimental compound composed of an alkali-metal cation and an electron in which the electron functions as a chemical element (e.g., a halogen) in salt formation. Several such compounds have been made in the U.S. and abroad. The phenomenon is reported to be one which challenges accepted concepts of compound formation.

electrochemical equivalent. The number of grams of an element or group of elements liberated by the passage of one coulomb of electricity (one ampere for one second).

Electrochemical Society (ECS). Established in 1902, this society was organized to promote the advance of the science of electrochemistry and related fields. It comprises 11 divisions, each devoted to a special branch of electrochemistry, e.g., corrosion, batteries, rare metals, electrodeposition, etc. It publishes a journal and sponsors books relating to its major interests. Its office is at 10 S. Main St., Pennington, NJ 08534.

electrochemistry. That branch of chemistry concerned primarily with the relationship between electrical forces and chemical reactions. This re-

"Polyphos" [Olin]. TM for a water-soluble glassy sodium phosphate of standardized composition ($\text{Na}_2\text{P}_2\text{O}_7$) analyzing 63.5% P_2O_5 ; (ratio of $\text{Na}_2\text{O}:\text{P}_2\text{O}_5$ is 1.2:1). It is closely similar to a sodium hexametaphosphate and sodium tetraphosphate; frequently the three names are used interchangeably.

Grade: Ground, walnut-size to pea-size lumps. **Use:** Boiler water compounds, detergents, textiles, leather tanning, photographic film developing, deflocculation of clays, flotation and desliming of minerals, dispersion of pigments, paper processing, industrial and municipal water treatment.

polysphosphate. See phosphazene.

polyphosphoric acid. $\text{H}_n\text{P}_n\text{O}_{3n+1}$ for n greater than 1. Any of a series of strong acids, from pyrophosphoric acid, $\text{H}_4\text{P}_2\text{O}_7$ ($n = 2$), through metaphosphoric acid (large values of n). **Properties:** Viscous, water-white liquid; water-soluble; does not crystallize on standing; hygroscopic. The commercial acid is a mixture of orthophosphoric acid with pyrophosphoric, triphosphoric, and higher acids and is sold on the basis of its calculated content of H_3PO_4 , e.g., 115%. Superphosphoric acid is a similar mixture sold at 105% H_3PO_4 . These acids revert slowly to orthophosphoric acid on dilution with water.

Hazard: Toxic by ingestion; strong irritant. **Use:** Dehydrating, catalytic, and sequestering agents, for metal treating; many applications where a concentrated, nonoxidizing acid is needed; lab reagent. See also phosphoric acid.

polypropylene. CAS: 9003-07-0. $(\text{C}_3\text{H}_5)_n$. A synthetic, crystalline, thermoplastic polymer with molecular weight of 40,000 or more. **Note:** Low molecular weight polymers are also known which are amorphous in structure, and used as gasoline additives, detergent intermediates, greases, sealants, and lube-oil additives. Also available as a high melting wax.

Derivation: Polymerization of propylene with a stereo-specific catalyst such as aluminum alkyl. **Properties:** Translucent, white solid with d 0.90; mp 168-171°C; tensile strength 5000 psi; flexural strength 7000 psi; usable up to 121°C. Insoluble in cold organic solvents; softened by hot solvents. Maintains strength after repeated flexing. Degraded by heat and light unless protected by antioxidants. Readily colored; good electrical resistance; low water absorption and moisture permeability; poor impact strength below -94°C; not attacked by fungi or bacteria; resists strong acids and alkalis up to 60°C, but is attacked by chlorine, fuming nitric acid, and other strong oxidizing agents. Combustible, but slow-burning. Fair abrasion and good heat resis-

tance if properly modified. Can be chrome-plated, injection- and blow-molded, and extruded.

Available forms: Molding powder: extruded sheet, cast film (1-10 mils), textile staple and continuous filament yarn, fibers with diameters from 0.05 to 1 μm and fiber webs down to 2 μm thick, low-density foam.

Use: Packaging film; molded parts for automobiles, appliances, housewares, etc.; wire and cable coating; food container closures; coated and laminated products; bottles; artificial grass and turfs; plastic pipe; wearing apparel (acid-dyed); fish nets; surgical casts; strapping; synthetic paper; reinforced plastics; nonwoven disposable filters.

polypropylenebenzene. See dodecylbenzene.

polypropylene, chlorinated. White, odorless, non-flammable powder. A film-forming polymer used in coatings, inks, adhesives, and paper coatings.

polypropylene glycol ester. Exactly analogous to polyethylene glycol ester.

polypropylene glycol monobutyl ether. See butoxy polypropylene glycol.

polypropylene glycol. (PG). $\text{HO}(\text{C}_3\text{H}_6\text{O})_n\text{H}$. One of a group of compounds comparable to polyethylene glycols but more oil-soluble and substantially less water-soluble. Classified by molecular weight as 425, 1025, 2025. Non-volatile, noncorrosive liquids; lower molecular weight members are soluble in water. Solvents for vegetable oils, waxes, resins. Combustible.

Use: Hydraulic fluids, rubber lubricants, anti-foam agents, intermediates in urethane foams, adhesives, coatings, elastomers, plasticizers, paint formulations, lab reagent.

polypropylenimine. Polymeric form of propylenimine. Available in 50% aqueous solution.

Use: Textile, paper, and rubber industries.

polypropylene oxide. $(\text{C}_3\text{H}_5\text{O})_n$. A derivative of propylene.

Use: Intermediate for urethane foams.

polypyrrolidone. Synonym for nylon-4.

"Polyrad" [Aqualon]. TM for reaction products of "Amine D" and ethylene oxide.

Grade: Various grades which differ in chain length of polyoxyethylene units and free amine content. Vary in viscosity at 25°C from 0.5-24.8 poises.

Use: Corrosion inhibitors and detergents in pe-

roleum processing equipment, wetting and emulsifying agents, inhibiting hydrogen chloride.

"Polymram" [FMC]. TM for a wettable powder. **Hazard:** Toxic by ingestion and inhalation. **Use:** Fungicide approved for many vegetables.

polyrotaxanes. Hoop-like molecules threaded as "rotors" on a linear polymer "axle." Up to 40 α -cyclodextrin (rotor) molecules have been threaded on a poly(iminooilomethylene) (hub) chain.

polysaccharide. A combination of nine or more monosaccharides, linked together by glycosidic bonds. Examples: starch, cellulose, glycogen. See also carbohydrate, phycolloid.

polysiloxane. See siloxane.

"Poly-Solv" [Olin]. TM for a series of glycol ether solvents for paints, varnishes, dry-cleaning soaps, cutting oils, insecticides.

polyorbate. (USAN name for a polyoxyethylene fatty acid ester). One of a group of nonionic surfactants obtained by esterification of sorbitol with one or three molecules of a fatty acid (stearic, lauric, oleic, palmitic) under conditions which cause splitting out of water from the sorbitol, leaving sorbitan. About 20 moles of ethylene oxide per mole of sorbitol are used in the condensation to effect water solution.

Properties: Lemon to amber, oily liquids; d 1.1; faint odor and bitter taste; most types are soluble in water, alcohol, and ethyl acetate. Combustible.

Grade: Polyorbate 20 (polyoxyethylene (20) sorbitan monolaurate). Polyorbate 60 (polyoxyethylene (20) sorbitan monooleate). Polyorbate 80 (polyoxyethylene (20) sorbitan monolaurate). Polyorbate 65 (polyoxyethylene (20) sorbitan trisecarate).

Use: Surfactant, emulsifying agent, dispersing agents, shortenings and baked goods, pharmaceuticals, flavoring agents, foaming and defoaming agents.

See also sorbitan fatty acid ester.

polystyrene. CAS: 9003-53-6. $(\text{C}_6\text{H}_5\text{CHCH}_2)_n$. Polymerized styrene, a thermoplastic synthetic resin of variable molecular weight depending on degree of polymerization.

Properties: Transparent, hard solid; high strength and impact resistance; excellent electrical and thermal insulator. Attacked by hydrocarbon solvents but resists organic acids, alkalis, and alcohols. Not recommended for outdoor use, as unmodified polymer yellows when exposed to light, but light-stable modified

grades are available. Easily colored, molded, and fabricated. Copolymerization with butadiene and acrylonitrile and blending with rubber or glass fiber increase impact strength and heat resistance; autoign temp 800°F. Combustible.

Derivation: Polymerization of styrene by free radicals with peroxide initiator.

Forms: Sheet, plates, rods, rigid foam, expandable beads or spheres.

Hazard: As for foam, plastic.

Use: Packaging, refrigerator doors, air conditioner cases, containers and molded household wares, machine housings, electrical equipment, toys, clock and radio cabinets. (As foam): thermal insulations, light construction as in boats, etc., ice buckets, water coolers, fillers in shipping containers, furniture construction. (As spheres): radiator leak stopper. See also "Styron", "Styrofoam".

polysulfide elastomer. A synthetic polymer in either solid or liquid form obtained by the reaction of sodium polysulfide with organic dichlorides such as dichloroethyl formal, alone or mixed with ethylene dichloride. Outstanding for resistance to oils and solvents and for impermeability to gases. They have poor tensile strength and abrasion resistance, but are resilient and have excellent low-temperature flexibility. Some grades have fairly strong odor, which is not objectionable in most applications. Sealant grades are furnished in two parts, which cure at room temperature when blended.

Use: Gasoline and oil-loading hose, sealants and adhesive compositions, binder in solid rocket propellants, gaskets, paint spray hose. See also "Thiokol".

polysulfone. A synthetic thermoplastic polymer. **Properties:** Hard, rigid, transparent solid. Tensile strength 10,000 psi, d 1.24, flexural strength 15,000 psi, good electrical resistance, minimum creep, low expansion coefficient. Soluble in aromatic hydrocarbons, ketones, and chlorinated hydrocarbons; resistant to corrosive acids and alkalis, to heat and oxidation and to detergents, oils, and alcohols. Dimensionally stable over temperature range -100 to +148°C; tends to absorb moisture, readily processed and fabricated. Combustible, but self-extinguishing.

Derivation: Condensation of bisphenol A and dichlorophenylsulfone.

Use: Power-tool housings, electrical equipment, extruded pipe and sheet, auto components, electronic parts, appliances, computer components, base matrix for stereotype printing plates.

polyterpene resin. A class of thermoplastic resins or viscous liquids of amber color, obtained by polymerization of turpentine in the presence of catalysts such as aluminum chloride or mineral